and 1 E 16 ions/cm^2.

31. The method according to Claim 28 wherein said TEOS-based silicon oxide etch stop layer has a thickness of between about 50 and 5000 Angstroms.

32. The method according to Claim 28 wherein said TEOS-based silicon oxide capping layer has a thickness of between about 50 and 5000 Angstroms.

REMARKS

Examiner J. L. Brophy is thanked for the thorough examination and search of the subject Patent Application. Claims 1, 6, 12, and 17 have been amended, Claims 2, 7-11, 13, and 18-22 have been cancelled, and new Claims 23-32 have been added.

The making final of the restriction requirement is noted. Non-elected Claims 7-11 and 17-22 are hereby canceled. A divisional application to the non-elected Claims will be filed once the elected Claims are Allowed.

The Specification has been amended to refer to the drawing reference number 20 in Fig. 2.

Claims 6 and 17 have been amended to overcome objection because of informalities. The Examiner is thanked for her very helpful suggestions in this matter.

New Claim 23 is similar to Claim 17, but for the capping oxide layer instead of the etch stop layer. New Claims 24-32 are similar to Claims 1-6 and 12-17, but written more narrowly to include the depth of the ion implantation.

All Claims are believed to be in condition for Allowance and that is so requested.

Reconsideration of the rejection under 35 U.S.C. 102 of Claims 1-3 and 6 as being anticipated by JP08102489A is requested in view of Amended Claim 1 and in accordance with the following remarks.

Applicants' invention provides a means for improving adhesion of a TEOS oxide layer to an underlying low dielectric constant material layer. Silicon ions are implanted into the underlying layer to improve adhesion. JP08102489A teaches implanting silicon ions into a plasma TEOS film to prevent moisture diffusion. Claim 1 has been amended to claim the specific materials of the low dielectric constant material layer from Claim 2. These materials are

not taught or suggested in the reference.

Reconsideration of the rejection under 35 U.S.C. 102 of Claims 1-3 and 6 as being anticipated by JP08102489A is requested in view of Amended Claim 1 and in accordance with the remarks above.

Reconsideration of the rejection under 35 U.S.C. 102 of Claims 1 and 2 as being anticipated by Muroyama is requested in view of Amended Claim 1 and in accordance with the following remarks.

Muroyama teaches implanting silicon ions into a thermal oxide film to make its surface hydrophobic. Claim 1 has been amended to claim the specific materials of the low dielectric constant material layer from Claim 2. These materials are not taught or suggested in Muroyama.

Reconsideration of the rejection under 35 U.S.C. 102 of Claims 1 and 2 as being anticipated by Muroyama is requested in view of Amended Claim 1 and in accordance with the remarks above.

Reconsideration of the rejection under 35 U.S.C. 102 of Claims 1-3 and 6 as being anticipated by Wantanabe et al is

requested in view of Amended Claim 1 and in accordance with the following remarks.

Wantanabe et al teaches implanting silicon ions into a spin-on-glass film to decompose its organic components. Claim 1 has been amended to claim the specific materials of the low dielectric constant material layer from Claim 2. These materials are not taught or suggested in Wantanabe et al.

Reconsideration of the rejection under 35 U.S.C. 102 of Claims 1-3 and 6 as being anticipated by Wantanabe et al is requested in view of Amended Claim 1 and in accordance with the remarks above.

Reconsideration of the rejection under 35 U.S.C. 103 of Claims 4 and 5 as being unpatentable over JP08102489A or Wantanabe et al is requested in view of Amended Claim 1 and in accordance with the following remarks.

JP08102489A teaches implanting silicon ions into a plasma TEOS film to prevent moisture diffusion. Wantanabe et al teaches implanting silicon ions into a spin-on-glass film to decompose its organic components. Claim 1 has been amended to claim the specific materials of the low dielectric

constant material layer from Claim 2. These materials are not taught or suggested in the references.

Reconsideration of the rejection under 35 U.S.C. 103 of Claims 4 and 5 as being unpatentable over JP08102489A or Wantanabe et al is requested in view of Amended Claim 1 and in accordance with the remarks above.

Reconsideration of the rejection under 35 U.S.C. 103 of Claims 3-6 as being unpatentable over Muroyama is requested in view of Amended Claim 1 and in accordance with the following remarks.

Muroyama teaches implanting silicon ions into a thermal oxide film to make its surface hydrophobic. Claim 1 has been amended to claim the specific materials of the low dielectric constant material layer from Claim 2. These materials are not taught or suggested in the reference.

Reconsideration of the rejection under 35 U.S.C. 103 of Claims 3-6 as being unpatentable over Muroyama is requested in view of Amended Claim 1 and in accordance with the remarks above.

Reconsideration of the rejection under 35 U.S.C. 103 of Claims 12-17 as being unpatentable over Wantanabe et al is requested in view of Amended Claim 12 and in accordance with the following remarks.

Wantanabe et al teaches implanting silicon ions into a spin-on-glass film to decompose its organic components. Claim 1 has been amended to claim the specific materials of the low dielectric constant material layer from Claim 2. These materials are not taught or suggested in the reference. It is agreed that forming a copper layer within an opening is taught in the reference, but this is not a damascene process.

Reconsideration of the rejection under 35 U.S.C. 103 of Claims 12-17 as being unpatentable over Wantanabe et al is requested in view of Amended Claim 12 and in accordance with the remarks above.

Applicants have reviewed the prior art not made of record and agree with the Examiner that while the references are of general interest, they do not apply to the detailed Claims of the present invention.

Allowance of all Claims is requested.

Attached hereto is a marked-up version of the changes made to the Claims by the current amendment. The attached pages are captioned "VERSION WITH MARKINGS TO SHOW CHANGES MADE."

It is requested that should Examiner Brophy not find that the Claims are now Allowable that she call the undersigned at 765 4530866 to overcome any problems preventing allowance.

Respectfully submitted,

Rosemary L. S. Pike. Reg # 39,332

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION

Please replace the first full paragraph of page 8 with the following:

Fig. 2 illustrates the silicon implantation pre-treatment of the present invention. Silicon ions are implanted 20 into the low-k material layer at an energy of between about 5 and 30 KeV with a dosage of between about 1 E 12 and 1 E 16 ions/cm^2. The targeted mean depth of implantation is between about 50 and 600 Angstroms. Fig. 3 illustrates the roughened silicon-implanted surface 21 of the low-k material layer 18.

IN THE CLAIMS

Please amend the Claims as follows:

1. (AMENDED) A method of forming a dielectric material layer comprising:

depositing a low dielectric constant material layer on a substrate wherein said low dielectric constant material comprises: porous or non-porous carbon-based

silicon oxides, porous or non-porous doped silicon oxides, porous or non-porous organic polymers, or porous or non-porous inorganic polymers;

implanting silicon ions into said low dielectric constant material layer; and

thereafter depositing a TEOS-based silicon oxide layer overlying said low dielectric constant material whereby there is good adhesion between said low dielectric constant material layer and said TEOS-based silicon oxide layer.

Please cancel Claim 2.

6. (AMENDED) The method according to Claim 1 wherein said TEOS-based [dielectric] silicon oxide layer has a thickness of between about 50 and 5000 Angstroms.

12. (AMENDED) A method of dual damascene copper metallization in the fabrication of an integrated circuit device comprising:

depositing a first low dielectric constant material layer over a substrate wherein said first low dielectric constant material comprises: porous or non-porous carbon-based silicon oxides, porous or non-porous doped silicon oxides, porous or non-porous organic polymers,

or porous or non-porous inorganic polymers;

implanting silicon ions into said first low dielectric constant material layer;

thereafter depositing a TEOS-based silicon oxide etch stop layer overlying said first low dielectric constant material whereby there is good adhesion between said first low dielectric constant material layer and said TEOS-based silicon oxide etch stop layer;

depositing a second low dielectric constant material layer overlying said etch stop layer wherein said second low dielectric constant material comprises: porous or non-porous carbon-based silicon oxides, porous or non-porous doped silicon oxides, porous or non-porous organic polymers, or porous or non-porous inorganic polymers;

implanting silicon ions into said second low dielectric constant material layer;

thereafter depositing a TEOS-based silicon oxide capping layer overlying said second low dielectric constant material whereby there is good adhesion between said second low dielectric constant material layer and said TEOS-based silicon oxide capping layer;

forming a dual damascene opening through said capping layer, said second low dielectric constant material layer, said etch stop layer, and said first low

dielectric constant material layer; and

forming a barrier metal layer and a copper layer within said dual damascene opening to complete said copper metallization in the fabrication of said integrated circuit device.

Please cancel Claim 13.

17. (AMENDED) The method according to Claim 12 wherein said TEOS-based [dielectric] <u>silicon oxide etch stop</u> layer has a thickness of between about 50 and 5000 Angstroms.